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A new concept of the aetiology and surgical repair of paraumbilical and epigastric hernias

Omar M Askar MS MD

Professor of General Surgery, Faculty of Medicine, University of Cairo, Kasr El-Aini Hospital, Cairo, Egypt

Summary

The aetiological factors concerned in the production of paraumbilical and epigastric hernias have been reviewed along structural–functional lines. A positive relation between the aponeurotic pattern and herniation was demonstrable at operation in 25 patients with paraumbilical or epigastric hernias. The effect of abdominal distension, obesity, and straining are discussed. A new type of surgical repair planned on this basis is described. The preliminary results obtained with this technique are reported, with a discussion of other previously described types of surgery.

Introduction

Our present knowledge of the mechanism of herniation through the aponeuroses of the abdominal wall is still incomplete. Little seems to have been achieved in this field since Mayo[1-3] described the transverse repair called after him. More recent investigators[4-8] seem to have added only more question marks.

With a realization of the functional significance of the aponeurotic pattern in the anterior abdominal wall, which was the subject of a previous article[9], a clearer understanding of the mechanism of herniation may be obtained, and on this basis a functionally sound surgical repair of aponeurotic hernial defects can be planned. A study of the relation of the anatomical pattern to herniation (paraumbilical and epigastric) has therefore been carried out and a new technique for the repair of aponeurotic hernial defects, planned on a structural–functional basis, has been devised and given preliminary clinical trials.

Material

The aponeurotic pattern was studied at operation in 25 patients, 10 male and 15 female, with paraumbilical or epigastric hernias. To facilitate study of the aponeurotic pattern the patients selected were not particularly obese and their hernias had not previously been operated upon. Their ages ranged from 25 to 55 years (Table I).

Of the 10 men, 9 had epigastric hernias (midway between the xiphoid process and the umbilicus) and one a paraumbilical hernia; 3 had chronic bronchitis and the remaining 7 were heavy smokers.

All the women had paraumbilical hernias and all were multiparae; 2 gave a history of twin pregnancy (Table II).

Technique

Epigastric hernias were exposed through longitudinal skin incisions and paraumbilical hernias through curvilinear incisions. The skin flaps were reflected far enough to allow

TABLE I *Size of hernia in relation to age and sex*

Size of hernia	*25–30 years* M	F	*31–40 years* M	F	*41–50 years* M	F	*51–55 years* M	F
Small	—	1	5	2	1	2	—	—
Moderate	—	1	1	2	2	3	1	1
Huge	—	—	—	—	—	2	—	1

TABLE II *Size of hernial defect in relation to number of pregnancies*

Size of hernial defect	*No of pregnancies* 2	3	4	5	6	7
2–3 cm	2	2	1	—	—	—
3–5 cm	—	—	2	3	3	—
5–7 cm	—	—	—	—	1	1

visualization of the aponeurotic pattern above and below the hernial defect or defects, the level, site, size, and number of which were recorded.

In cases with lipoma herniae the lump of fat was excised after ligation of its base (Fig. 7b). Small peritoneal saccules were reduced unopened. Well-formed hernial sacs were carefully dissected from the edges of the defect, the contents released, and the peritoneum closed separately (Fig. 1).

Hernial defects less than 2.5 cm in diameter were closed with two or more mattress sutures placed obliquely (in the same direction as the aponeurotic fibres). Larger defects were darned. A piece of fascia lata (autograft) varying in size according to the size of the defect was cut longitudinally into strips 3–4 mm in breadth. These were used to fashion an obliquely placed interwoven mesh over the hernial defect (Fig. 2). The strips, after being threaded into the non-scarred aponeurosis, were fixed to the edges of the defect with 00 chromic catgut sutures, only moderate tension being applied. Abdominal lipectomy was performed at the same time on 6 patients presenting with a pendulous belly.

Results

In all 9 men with epigastric hernias a single line of decussation was observed (Fig. 7b). The hernial orifices were in the midline situated about midway between the xiphoid and the umbilicus, oval in shape, and transversely placed, the wider diameter ranging between 7 and 12 mm. In 6 cases the hernia consisted only of a protrusion of extraperitoneal fat; in the other 3 cases small peritoneal saccules were reduced unopened.

The 10th male patient, who was moderately obese, had a paraumbilical hernia with a single midline defect which was rounded, measuring 2 cm in diameter. He also showed a single line of decussation.

Of the 15 women, 12 had their hernial defects exactly in the midline, 1–2 cm above the umbilicus; their lineae albae showed a single pattern of decussation (Fig. 3). In the remaining 3 cases the hernial defects were situated in close proximity to the umbilicus to the left of the midline (Fig. 4a). They presented a triple pattern of decussation (Fig. 4b). Two of these 3 patients (with a history of twin pregnancy) had small accessory hernial defects on the other side of the midline.

Postoperative recovery was smooth in all cases. Slight superficial wound sepsis occurred in 3 obese women; it readily responded to drainage and antibiotics.

On follow-up for 4–5 years no recurrence was observed among patients in whom the darning technique had been used. The only recurrence was in one of the 7 women in whom the defect had been closed with mattress sutures. It was dealt with later by darning and she was included in another series of cases still under investigation.

Discussion

AETIOLOGY

A positive relation between the pattern of aponeurotic decussation and herniation was demonstrable in this series of cases. The very high incidence of a single pattern of decussation (88%) may provide an answer to the question why some people develop hernias and others do not. The fact that with a single midline decussation a midline hernial defect is seen while with a triple decussation the hernial orificc occurs to one side of the midline indicates that the triple pattern seems to give the midline some degree of immunity to herniation.

The mechanism of herniation through the midline aponeurotic area (linea alba) remains,

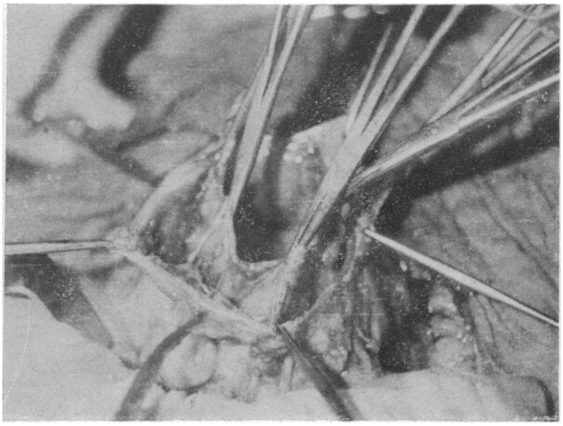

FIG. 1 *Peritoneum dissected from edges of hernial defect to allow for separate closure.*

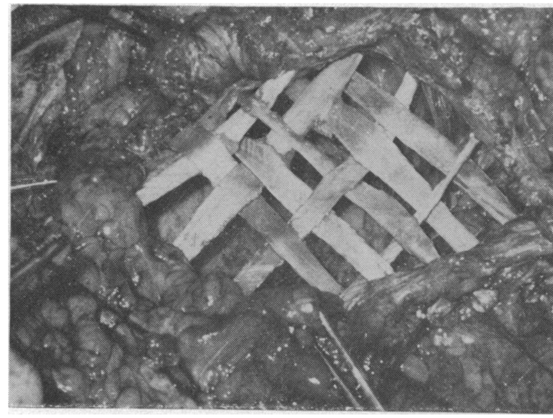

FIG. 2 *Hernial defect darned with strips of fascia lata fashioned into a criss-cross interwoven mesh obliquely placed over the defect.*

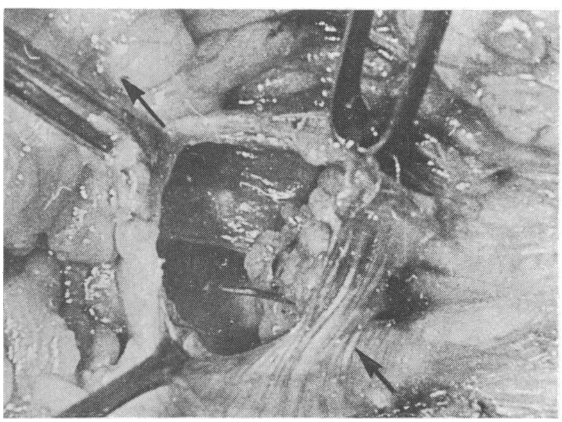

FIG. 3 *Midline paraumbilical hernial defect (female) showing single midline decussation. Note the overstretched torn aponeurotic fabric at the inferior edge of the defect. (Arrows delineate the midline).*

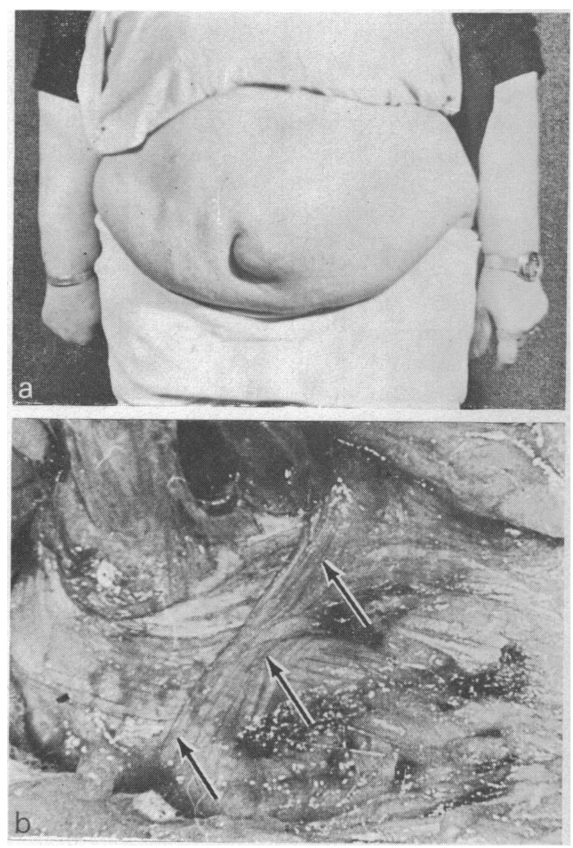

FIG. 4 *(a) Paraumbilical hernia to the left side of the midline in a woman. (b) Hernial defect in same case showing triple pattern of decussation (arrowed). The left lateral decussation is seen pushed medially (to be compared with Fig. 3).*

so far, vaguely explained. Congenital widening of the umbilical orifice can be accepted as a predisposing factor in true umbilical hernia[10-13]. An equally convincing explanation has not been given for paraumbilical hernia. The most reasonable hypothesis seems to be the one given by Mayo[3]. He considered paraumbilical hernias to be caused by downward traction on the abdominal wall bearing on a fixed point at the umbilicus associated with an increase of the vertical and, to a lesser extent, the lateral dimension of the abdominal wall. However, a description of the mechanism entailed in the production of such changes was not given.

The obliquity in which the fibres in the aponeurotic fabric are placed (Figs 3 and 9) suggests a special design allowing for free mobility and change of shape of the aponeurosis in adaptation to movements of the trunk and with respiration[9]. It can be seen (Figs 5 and 6) that an increase in the length of the midline aponeurotic area takes place at the expense of its breadth and vice versa. An increase of both length and breadth at the same time is not normally allowed. In abdominal distension the aponeurosis is overstretched in both its longitudinal and transverse diameters, the former, owing to the free mobility of the aponeurosis, suffering more.

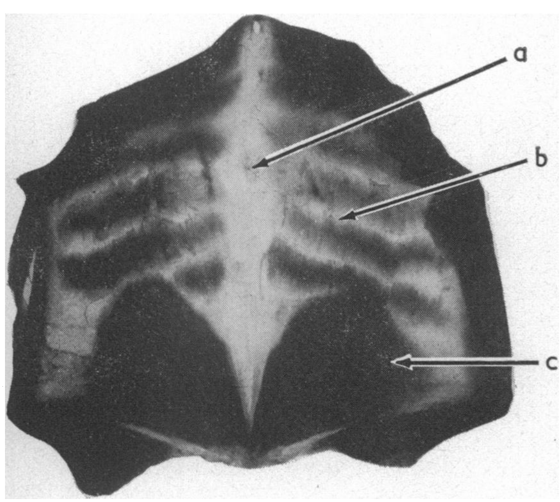

FIG. 5 *Silhouette picture of anterior abdominal wall (normal adult postmortem specimen) demonstrating: (a) midline aponeurotic area, (b) active upper respiratory zone, (c) passive lower 'belly support' zone.*

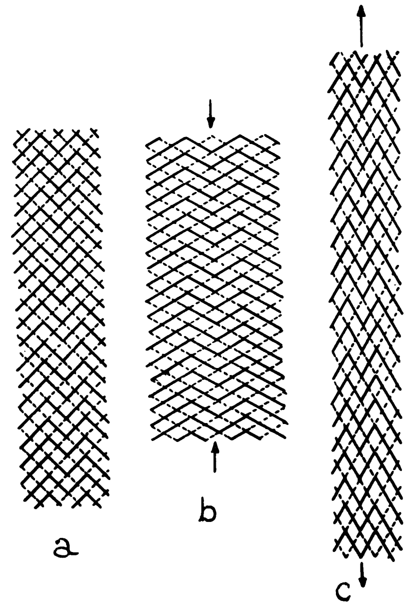

FIG. 6 *Diagram demonstrating changes in length and breadth at the midline aponeurotic area: (a) neutral position; (b) shortening in the longitudinal diameter with broadening of the transverse diameter; (c) elongated longitudinal diameter with narrowed transverse diameter.*

This provides a reasonable anatomical explanation for the observations of Mayo[3].

The higher incidence of paraumbilical hernia in women was attributed by Battle[11, 12], Baegeli[14], and Mair[8] to pregnancy and obesity. However, the effect of pregnancy and/or obesity on the abdominal wall aponeuroses has not been sufficiently clarified. In my previous investigations[9] allowance for physiological grades of distension was demonstrable in the central zone around the umbilicus; abdominal distension overshooting the permissible limits would thus tend to throw its greatest load on this area. This offers an explanation why paraumbilical hernias are commoner in women. With a midline single decussation the tear would be in the midline; with a triple pattern the defect would occur to one side of the midline (Figs 3, 4a, 4b).

The fetal presentation may have some relation to the development of paraumbilical hernia to one or other side of the midline. In left occipitoanterior presentations (55–65%), with more fetal bulk on the left side, pressure is exerted maximally on the aponeurosis at a point to the left of the umbilicus. In this study the 3 women presenting with triple decussation had their hernial orifices to the left of the midline. This point is still under investigation, awaiting further confirmation.

Other factors seem further to predispose the central aponeurotic zone to herniation; this zone, being a transitory area between the actively mobile upper respiratory and the lower passive 'belly support' zones (Fig. 5), is subjected to constant stress. With a change from the firmer triple to the single pattern of decussation the durability of the aponeurotic fabric is reduced[9]. Furthermore, most of the aponeurotic fibres in this area lose their obliquity in the change to the downward, medial direction needed for the integrity of the belly support. A horizontal direction makes the aponeurotic fibres far less resistant to stretch.

In obesity the deposition of fat is both intra-abdominal and subcutaneous. An increased bulk of abdominal contents increases the intra-abdominal tension. The subcutaneous deposition sags down to form a pendulous belly, the size and weight of which can be quite remarkable so that it may exert a considerable amount of downward traction on the aponeurosis above the umbilicus. The midline aponeurotic area is thus overstretched in both its longitudinal and transverse diameters and may easily give way. The value of lipectomy seems to lie mainly in the relief of this harmful downward traction on the aponeurosis.

Epigastric hernias were believed to start as a protrusion of a lobule of fat through an abnormally wide opening for a blood vessel or a congenital defect in the linea alba[6, 14, 16, 17]. The fact that all such hernias are in the midline, the hernial orifices being oval in shape and transversely placed, points to a pulling action exerted on the aponeurosis at this particular spot. This favours my own belief that the aponeurotic phrenic slips working on a single midline decussation constitute the main causative factor in the production of epigastric hernias (Figs 7 and 8).

The commoner incidence of epigastric hernias in men may also find an explanation in the foregoing. As straining and coughing constitute the main aetiological factors in males, their hernias are often epigastric. In women abdominal distension due to pregnancy and obesity are the commonest causes for herniation, so that their hernias are mostly paraumbilical.

SURGICAL REPAIR

With an appreciation of the changes in the aponeurotic pattern which lead to the production of a hernial defect it

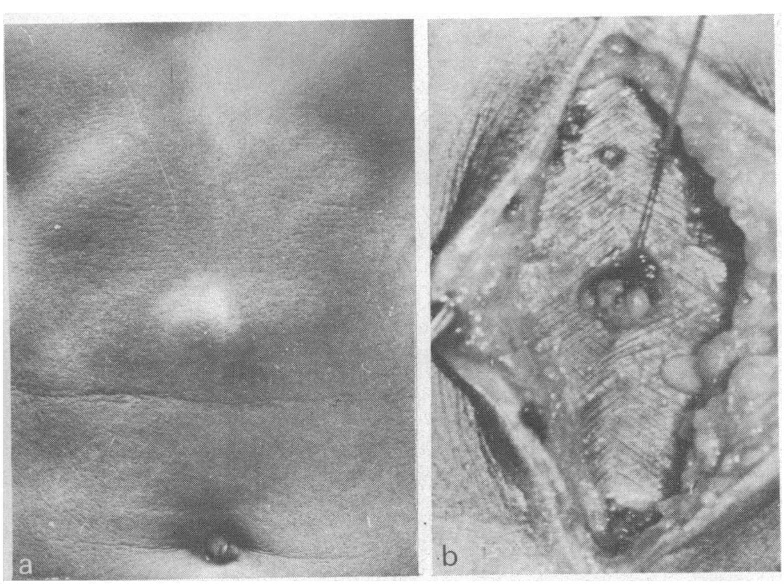

FIG. 7 *(a) Epigastric hernia, strictly midline. (b) Same case at operation showing single pattern of decussation. A ligature is applied to the lump of fat at its base.*

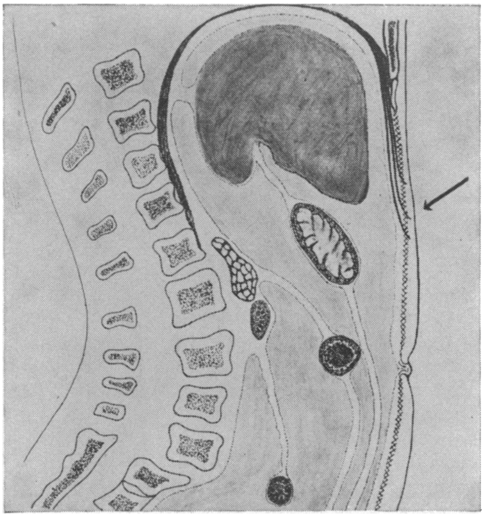

FIG. 8 *Diagram demonstrating the way in which aponeurotic slips descend from the sternocostal portion of the diaphragm to gain insertion into the midline aponeurotic area (linea alba) midway between xiphoid and umbilicus.*

seems evident that neither a horizontal 'transverse overlap' (Mayo's) nor a vertical repair would be physiologically sound.

A look at the aponeurotic pattern (Fig. 9) shows that the direction of pull on the midline aponeurotic area (linea alba) is oblique and never transverse. A horizontal overlap means a further pull on an aponeurosis which has already been overstretched in its longitudinal diameter to such an extent that it has torn (Fig. 3). The already exhausted aponeurotic fabric tends to re-tear either at the site of the transverse overlap or in its vicinity. Recurrent hernial defects are often larger than the original ones. Attempts at widening the hernial defect in the transverse direction to allow for a more ample overlap cuts more aponeurotic fibres and favours recurrence at the lateral extremities of the repair. Recurrence often occurs much earlier than is expected. It is reported to occur in the first few postoperative months[8]. Stitches may be heard giving way while a patient is still on the operating table coming round from the anaesthetic, particularly if a transverse overlap has been used for the closure of a big recurrent hernial defect.

In Mayo's series recurrence was reported in only 2 out of 75 cases. This result, however, has not been equalled by anyone before or since[8]. In the experience of Kelly[4], Pringle[5], Du Bose[6], and Turner[13] the results of this operation were not satisfactory, the recurrence rate in their series ranging between 22 and 40%. The lowest figure (7.5%) seems to be the one given by Gibson and Gasper[18].

A longitudinal repair on the other hand tends to approximate the edges of an aponeurotic fabric already torn as a result of an overstretched transverse diameter. Favourable results of this type of repair could not be gathered from the literature[4, 19-21]. Furthermore, a longitudinal repair carries all the disadvantages of a midline incision[22]. Attempts at widening the hernial defect in a longitudinal direction to achieve what may be thought to be an anatomical repair often aggravates the situation, particularly with a fairly weak single midline decussation.

More formidable types of repair[4-6, 23] may produce more serious derangements of function of the abdominal wall than those caused by the herniation.

The addition of more layers in an attempt to reinforce the repair[8, 24, 25] does not seem to have materially improved the situation. The problem does not seem to be that of the demand for additional layers so much as for an appreciation of the structural–functional basis of such a repair. Far better results would be expected if tantalum mesh or the like were obliquely and not transversely placed (Fig. 9).

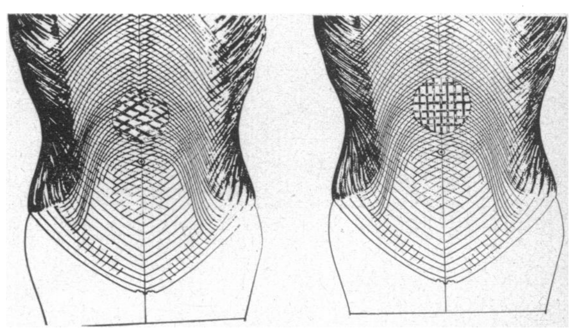

FIG. 9 *Diagram demonstrating how an obliquely placed interwoven mesh (author's technique) (left) would match with the obliquity of the aponeurotic pattern, while a transversely placed mesh (right) looks obviously unmatched.*

In planning for a physiologically sound hernial repair the following factors should be taken into consideration: (1) The operative procedure should not interfere with the biomechanics of the abdominal wall and should carry the least damage to the already torn aponeurosis. (2) A physiologically sound repair should in the first place aim at the restoration of the anatomical pattern of the torn aponeurosis to the normal. If that is not possible a pattern nearest to the normal should be produced.

The technique here reported of darning big hernial defects with an obliquely placed criss-cross interwoven mesh of fascia lata strips should be regarded as an attempt to simulate the normal aponeurotic pattern. Encouraged by the results of this new technique I have now operated upon 52 additional patients. Some of them were crippled patients with unusually large hernias; others were miserable patients with recurrent and incisional hernias. Though the final results are still under investigation awaiting the addition of more cases and a longer follow-up, yet the provisional results seem most satisfactory. Recurrence has not been observed after the darning operation in patients followed up over 4 years.

References

1 Mayo, W J (1899) *Annals of Surgery, 29,* 51.
2 Mayo, W J (1903) *Journal of the American Medical Association, 41,* 225.
3 Mayo, W J (1907) *Journal of the American Medical Association, 48,* 1842.
4 Kelly, R (1910) *Annals of Surgery, 51,* 694.
5 Pringle, S (1913) *Edinburgh Medical Journal, 10,* 493.
6 Du Bose, M (1915) *Surgery, Gynecology and Obstetrics, 21,* 771.
7 Roeder, T (1925) *Surgery, Gynecology and Obstetrics, 40,* 707.
8 Mair, G B (1945) *British Journal of Surgery, 32,* 381.
9 Askar, O (1977) *Annals of the Royal College of Surgeons of England, 59,* 313.
10 Palmer, T (1911) *Surgery, Gynecology and Obstetrics, 12,* 526.
11 Battle, W (1912) *Lancet, 2,* 931.
12 Battle, W (1912) *Lancet, 2,* 997.
13 Turner, G (1937) in *British Encyclopaedia of Medical Practice,* vol. 6, p 495. London, Butterworths.
14 Baegeli, T (1939) quoted by Watson, L F, *Hernia.* London, Kimpton.
15 Lathrop, G (1916) *Journal of the American Medical Association, 67,* 487.
16 Terrier, M (1892) quoted by Berger in *Traité de chirurgie,* ed. Duplay, S, and Reclus, P, p 796. Paris, Masson.
17 Moschowitz, A V (1915) *Annals of Surgery, 61,* 571.
18 Gibson, T, and Gasper, W (1959) *International Abstracts of Surgery, 109,* 313.
19 Gussenbauer, F (1884) *Prager medizinische Wochenschrift, 9,* 1.
20 Fairfield, J (1915) *Surgery, Gynecology and Obstetrics, 21,* 777.
21 Cooper, A (1827) *The Anatomy of Surgical Treatment of Abdominal Hernia.* London, Key, Longman.
22 Askar, O To be published.
23 Wells, C (1969) quoted by Aldis, A S, in *Operative Surgery,* ed. Rob, C G, and Smith, R, vol. 5, p. 341. London, Butterworths.
24 Gallie, F, and Le Mesurier, C (1921) *Canadian Medical Association Journal, 11,* 504.
25 Koontz, A R (1948) *Transactions of the Southern Surgical Association, 60,* 394.